

**PHYTOTOXICOLOGY 1996 MERCURY
IN TREE FOLIAGE INVESTIGATION:
ICI FOREST PRODUCTS
CORNWALL**

MAY 1998

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Report No.: SDB-009-3511-97

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Executive Summary

MOEE vegetation and air sampling revealed that ICI continued to be a mercury source in 1996. Air monitoring indicated that the mercury cell room, despite closure in 1995 and subsequent decommissioning, was the primary source of mercury to the atmosphere during the 1996 growing season. Contaminated soil at ICI was also a mercury source, but to a lesser extent. Tree foliage mercury levels in 1996 increased slightly at some sites from the record low levels of 1995, although, on average, the 1996 mercury concentrations were still the second lowest since the survey began in 1976. Only three sample sites exceeded the ULN in 1996 and these were within 500 m of ICI. In most previous years the ULN was exceeded at sites up to about 1 km east of ICI.

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Phytotoxicology 1996 Mercury in Tree Foliage Investigation: ICI Forest Products Inc., Cornwall

Introduction

Monitoring by the Ontario Ministry of the Environment and Energy (MOEE) continued after the ICI chlor-alkali plant in Cornwall closed in March 1995. Vegetation and air sampling revealed that ICI continued to be a mercury (Hg) source during the 1995 growing season due to volatilization of mercury still present at ICI (eg. Hg cell room, in/on soil etc.). Tree foliage mercury levels declined markedly at some sites following the closure, but remained elevated in the immediate area of ICI. However, sampling of area gardens in 1995 revealed that there was no health threat in consuming locally grown vegetables (Ref. 1). Decommissioning of the ICI cell room commenced following the plant closure, and the mercury inventory at ICI had been removed from the property prior to the 1996 growing season. As decommissioning activities extended into 1996, with soil remediation getting underway during the summer, the MOEE foliage survey around ICI was repeated in 1996. The MOEE Phytotoxicology Section has conducted regular foliage surveys to assess the status of mercury emissions from ICI since 1976. Air monitoring by the MOEE's Environmental Monitoring and Reporting Branch (EMRB) also was conducted in 1996 and previous years, at the request of the MOEE Cornwall District office. The 1996 air survey report has been forwarded by EMRB to the Cornwall office. This report presents the results of the most recent (1996) Phytotoxicology investigation.

Sampling / Submission for Analysis

On August 19 1996, staff of the Phytotoxicology Section collected foliage from nine regular sampling sites (Sites 1, 2, 4, 6, 8, 9, 10, 11, 14) in the immediate area of ICI. Most sites were situated in the residential area immediately east of ICI (see map attached). At all sites, duplicate foliage samples were collected from exposed middle branches, following standard MOEE sampling procedures (Ref. 5).

All foliage samples were returned to the Phytotoxicology laboratory and processed (oven dried, ground, stored in glass jars). They were then submitted to the MOEE's Laboratory Services Branch for mercury analysis.

Analytical Results

The mercury results in the attached table are reported as $\mu\text{g/g}$ (micrograms per gram, commonly referred to as ppm or parts per million). The foliar results are compared with the previous years' control data obtained in Ingleside (>20 km E), and with the Phytotoxicology Section Upper Limit of Normal (ULN) urban guideline (see appendix). ULNs reflect the expected upper limit of normal concentrations in urban areas not influenced by point sources of emissions. A level greater than the ULN indicates the likely presence of a local source.

The table compares the tree foliage mercury concentrations within 500 m of ICI with those at more distant sites (beyond 500 m) for all surveys since 1987. All shaded results exceeded the ULN ($0.3 \mu\text{g/g}$). Foliar mercury levels at most sites (6 out of 9) had slightly increased from the record low levels of 1995, with the 1996 results being the second lowest since the survey began in 1976 (Ref. 2). In 1996, foliar mercury levels exceeded the ULN only at Sites 4, 6 and 14. Site 4, which was the closest sample tree to ICI, had the highest mercury concentration ($1.8 \mu\text{g/g}$). This site has traditionally had one of the highest foliar mercury concentrations. As in 1995, mercury levels in tree foliage declined sharply with increasing distance from ICI. All sites exceeding the ULN were within 500 m of ICI.

The foliar data indicates that mercury was still present at ICI and that it was volatilized/released to the atmosphere during the 1996 growing season. This led to elevated mercury levels in tree foliage as a result of foliar uptake of mercury from the air. Results of the MOEE garden study in 1993 were consistent with the literature, which indicates that root uptake of mercury from soil is minimal (Ref. 3). ICI decommissioning activities likely contributed to the elevated foliar mercury levels. Site/soil disturbance associated with decommissioning could enhance volatilization through exposing mercury to the atmosphere, as well as result in fugitive emissions of particulate (e.g. soil) laden with mercury.

Despite the slight increase relative to 1995, foliar mercury levels in 1996 were still considerably lower than the generally high concentrations that were common in trees sampled prior to the closure of the ICI chlor-alkali plant (March 1995). The mean mercury concentration of the five foliage sites within 500 m of ICI in 1995 and 1996 (0.75 and $0.80 \mu\text{g/g}$, respectively) were at least 50% lower than all previous years, except 1992. Since 1987, the mean mercury concentration of these five sites ranged from a high of $4.93 \mu\text{g/g}$ (1987) to a low of $0.75 \mu\text{g/g}$ (1995). The number of sample sites exceeding the ULN was the lowest in 1996 (3 sites). Also, in 1996, Site 2 did not exceed the ULN for the first time since Phytotoxicology foliar sampling was initiated in 1976.

MOEE Air Monitoring Survey (1996)

The ambient air survey by the MOEE's Specialized Air Monitoring Section (EMRB) conducted in late August 1996 indicated that ICI's Hg cell room was the principal mercury source. Fugitive mercury emissions from contaminated soil also certainly occur but it is not known what

component of the total mercury lost from the ICI property this represents. The 1996 ambient mercury concentrations in air were similar to the 1993 and 1995 levels, with the maximum half-hour average of 600 ng/m³ in 1996 being slightly lower than the maximum levels of 810 ng/m³ in 1993 and 860 ng/m³ in 1995. As in previous years, the MOEE air standard for mercury (5000 ng/m³) was not exceeded (Ref. 4).

Conclusion

MOEE vegetation and air sampling revealed that ICI continued to be a mercury source in 1996. Air monitoring indicated that the mercury cell room, despite closure in 1995 and subsequent decommissioning, was the primary source of mercury to the atmosphere during the 1996 growing season. Contaminated soil at ICI was also a mercury source, but to a lesser extent. Tree foliage mercury levels in 1996 increased slightly at some sites from the record low levels of 1995, although, on average, the 1996 mercury concentrations were still the second lowest since the survey began in 1976. Only three sample sites exceeded the ULN in 1996 and these were within 500 m of ICI. In most previous years the ULN was exceeded at sites up to about 1 km east of ICI.

References:

- 1) Emerson, R. N. 1996. Phytotoxicology Vegetation and Soil Mercury Results: ICI, Cornwall (1995). Report No.: SDB-074-3511-95. Phytotoxicology Section, Standards Development Branch, MOEE.
- 2) Dixon, M. and R. N. Emerson 1994. Phytotoxicology Assessment Survey in the Vicinity of ICI Forest Products and Domtar, Cornwall (1987 to 1991). Report No.: PIBS 2829. Phytotoxicology Section, Standards Development Branch, MOEE.
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- 4) Karellas, N. 1996. Technical Memorandum: 1996 ICI Forest Products (Cornwall) Survey: Results of the Mobile TAGA. Environmental Monitoring and Reporting Branch, MOEE.
- 5) Ontario Ministry of the Environment. Phytotoxicology Field Investigation Manual Part 1 General Methodology. May 1993. Report No. HCB-014-3511-93.

Foliage Sites Sampled in the Vicinity of ICI Forest Products Since 1976.

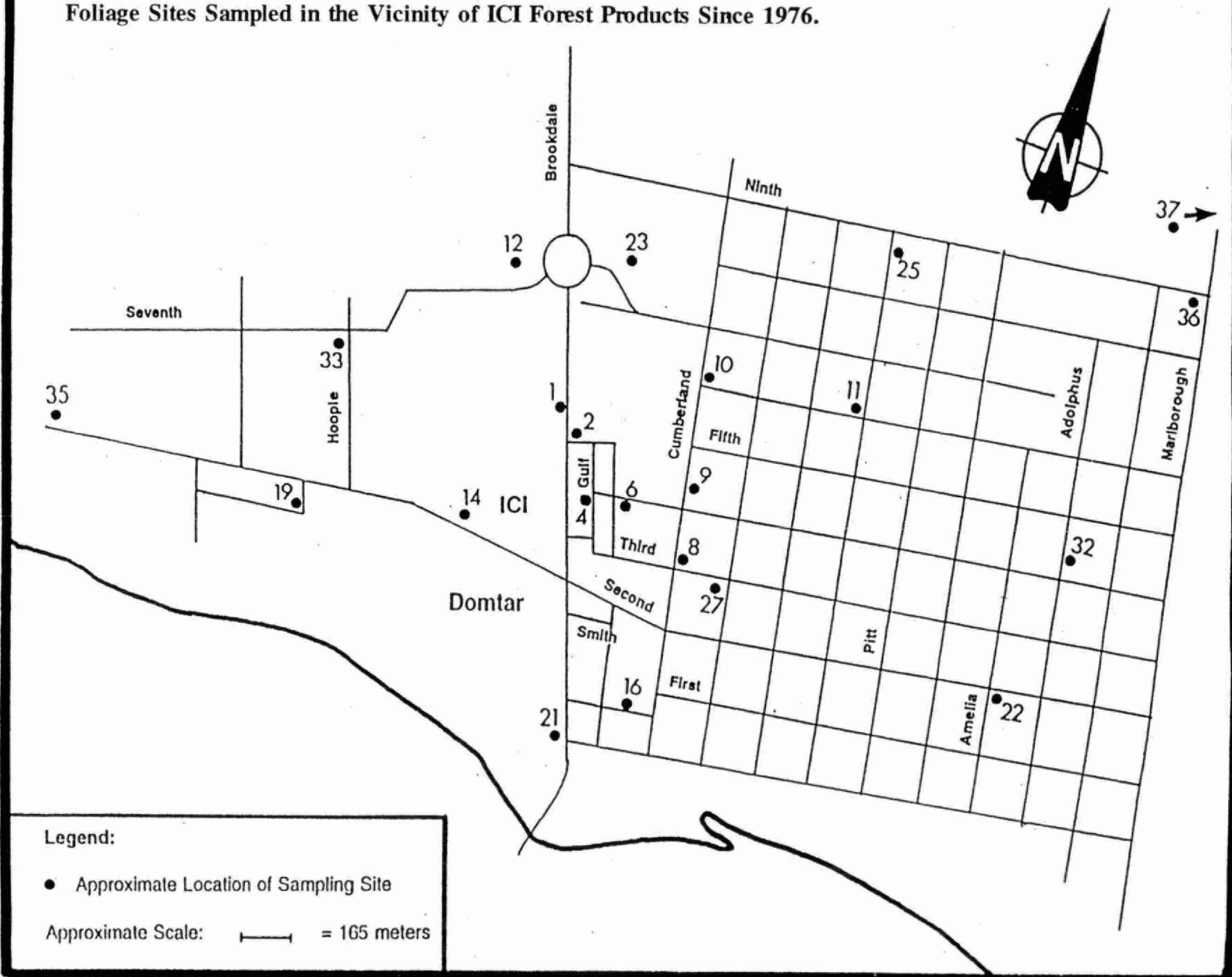


Table : Tree Foliage Mercury Concentrations: ICI, Cornwall - August, 1996

Site	Distance from ICI (meters)	Maple Species	Foliar Mercury Concentration*								
			1987	1989	1990	1991	1992	1993	1994	1995	1996
Sites Within 500 m of ICI											
1	360 N	Silver	0.80	0.26	0.27	0.24	0.50	0.55	0.25	0.13	0.12
2	360 NNE	Manitoba	0.30	0.85	0.92	1.90	0.69	2.90	0.86	1.57	0.24
4	240 E	Manitoba	0.50	0.30	0.75	0.60	1.30	2.55	1.35	0.72	0.27
6	400 ENE	Sugar	3.00	2.50	4.25	2.90	2.30	2.80	2.75	1.33	1.05
14	240 SW	Norway	0.96	0.48	0.78	1.10	0.35	1.55	1.08	1.76	1.45
Mean			4.93	1.56	2.98	1.75	1.03	4.46	1.62	0.75	0.80
Sites Greater than 500 m											
8	560 E	Red	0.75	0.37	0.17	0.59	0.41	0.74	0.30	0.14	0.17
9	600 ENE	Silver	1.65	0.65	0.62	0.82	0.79	1.10	1.20	0.27	0.30
10	750 NNE	Silver	0.45	0.18	0.01	0.21	0.22	0.74	0.22	0.06	0.09
11	1,120 NE	Silver	1.15	0.35	0.01	0.46	0.41	0.27	0.32	0.13	0.08
Mean			1.00	0.39	0.20	0.54	0.46	0.71	0.44	0.15	0.16
Overall Mean (All Sites)			3.18	1.04	1.75	1.21	0.78	2.79	1.09	0.48	0.51
Controls (Ingleside)		Manitoba	0.04	0.06	0.03	0.03	0.04	0.10	0.01 W	0.01 W	NR
		Silver	0.03	0.05	0.03	0.02	0.03	0.08	0.01 W	0.02 T	NR
		Norway	NR	0.04	0.04	0.02	0.03	0.06	0.01 W	0.01 T	NR
* ug/g, dry wt. Mean of duplicate samples and analysis. T - A measurable trace amount. W - Concentration is less than analytical detection limit (0.01 ug/g). NR - No result, samples not collected. Shaded data exceed the urban ULN guideline (0.30 ug/g), see Appendix.											

Appendix

Derivation and Significance of the MOEE Phytotoxicology "Upper Limit of Normal" Contaminant Guidelines".

The MOEE Upper Limits of Normal (ULN) contaminant guidelines represent the expected maximum concentration in surface soil, foliage (trees and shrubs), grass, moss bags, and snow from areas in Ontario not exposed to the influence of a pollution source. Urban ULN guidelines are based on samples collected from urban centres, whereas rural ULN guidelines were developed from non-urbanized areas. Samples were collected by Phytotoxicology staff using standard sampling procedures (reference: *Ontario Ministry of the Environment. 1989. Ontario Ministry of the Environment "Upper Limit of Normal" Contaminant Guidelines for Phytotoxicology Samples. Phytotoxicology Section, Air Resources Branch: Technical Support Sections NE and NW Regions, Report No. ARB-138-88-Phyto. ISBN: 0-7729-5143-8.*). Chemical analyses were conducted by the MOEE Laboratory Services Branch.

The ULN is the arithmetic mean plus three standard deviations of the suitable background data for each chemical element and parameter. This represents 99% of the sample population. This means that for every 100 samples that have not been exposed to a pollution source, 99 will fall within the ULN.

The ULNs do not represent maximum desirable or allowable limits. Rather, they are an indication that concentrations that exceed the ULN may be the result of contamination from a pollution source. Concentrations that exceed the ULNs are not necessarily toxic to plants, animals, or people. Concentrations that are below the ULNs are not known to be toxic.

ULNs are not available for all elements. This is because some elements have a very large range in the natural environment and the ULN, calculated as the mean plus three standard deviations, would be unrealistically high. Also, for some elements, insufficient background data is available to confidently calculate ULNs. The MOEE Phytotoxicology ULNs are constantly being reviewed as the background environmental data base is expanded. This will result in more ULNs being established and may amend existing ULNs.



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